YAKEEN

NEET 3.0 2026

Botany

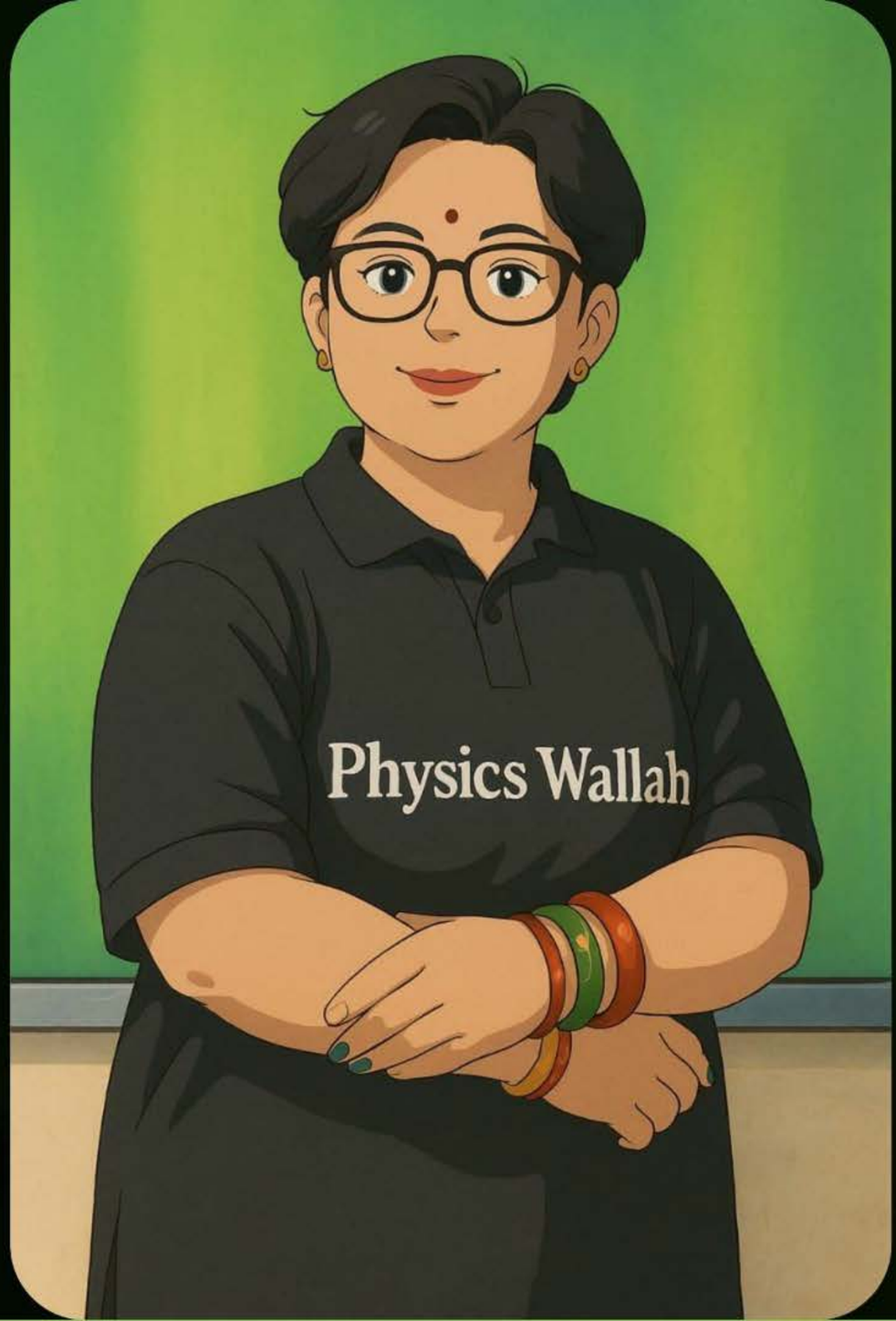
Cell Cycle & Cell Division

Lecture - 05

Dr. Akanksha Ma'am

Topics to be covered

1. Meiosis - II
2. Check - points
3. Amitosis



Recap of previous lecture

1. Meiosis

@BIOLOGYBYAK
ANKSHAMAM

DA

@AAMAM_BIO

Marks ≠ Success

DIAGNOSIS AND TREATMENT

With Your

GURUMAA

Immunity Booster = Short Notes

Last Class

MEIOSIS

- 2 cycles of Nuclear and Cell division
- DNA Replicate Once

PROPHASE-I

- Chr. condensation Continues throughout
- Chromosomes become gradually visible (light microscope)

I LEPTOTENE

II ZYGOTENE

- Synapse formed
- Synaptonemal Complex
  - Nucleoprotein
- Bivalents / Tetrad formed

III PACHYTENE

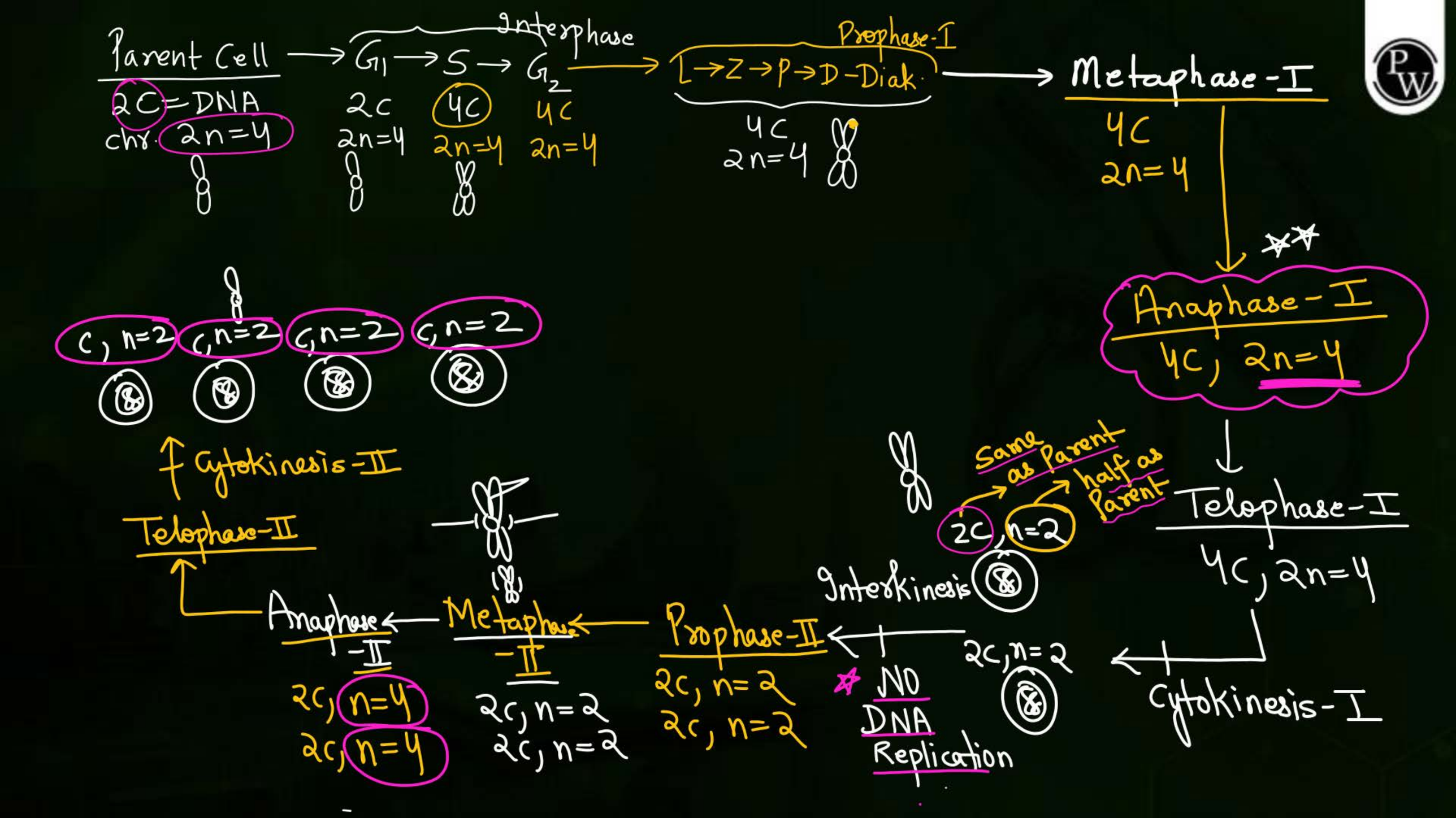
- Genetic Recombination | Crossing Over
  - Exchange of Genetic material between Non-sister Chromatids of Homologous chromosomes
- Tetrads clearly visible
- Enzyme mediated - RECOMBINASE
- longer than Leptotene & Zygotene

IV DIPLOTENE

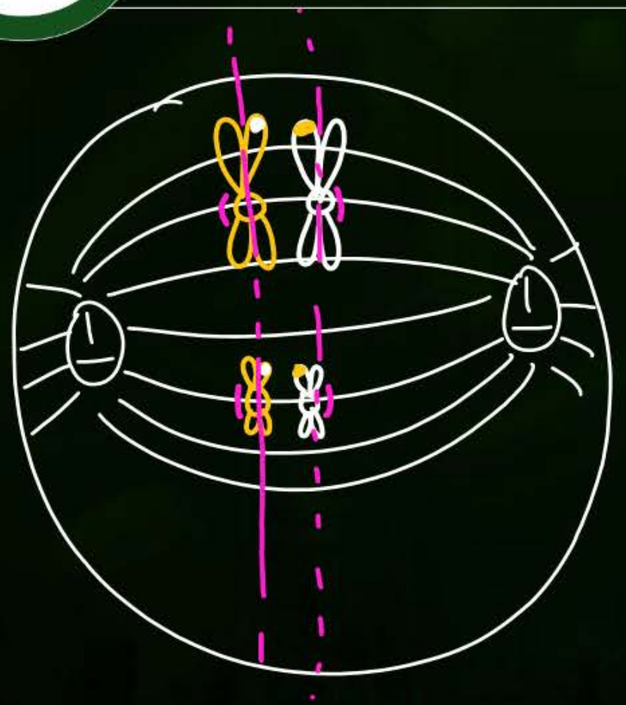
- Dissolution of Synaptonemal Complex
- Recombined homologous chr. of bivalent separate, except at point of Cross-Over
- X-shaped : CHIASMATA formed
- Oocytes (some Vertebrate) : Months-Years

V DIAKINESIS

- Terminalisation of Chiasmata
- Chr. fully Condensed
- Meiotic Spindle formed
- Nuclear membrane breakdown
- Nucleolus disappear

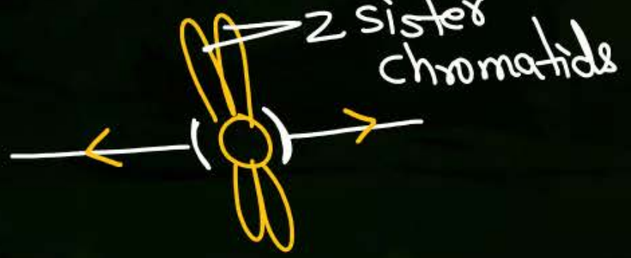

Parent Cell
2C = DNA
chr. 2n = 4
Interphase
G1 → S → G2
2C 4C 4C
2n=4 2n=4 2n=4
Prophase-I
L → Z → P → D - Diak
4C
2n=4
Metaphase-I
4C
2n=4
Anaphase-I
4C, 2n=4
Telophase-I
4C, 2n=4
Cytokinesis-I
Same as Parent
half as Parent
2C, n=2
Interkinesis
2C, n=2
NO DNA Replication
Prophase-II
2C, n=2
2C, n=2
Metaphase-II
2C, n=2
2C, n=2
Anaphase-II
2C, n=4
2C, n=4
Telophase-II
Cytokinesis-II
C, n=2
C, n=2
C, n=2
C, n=2

Metaphase I

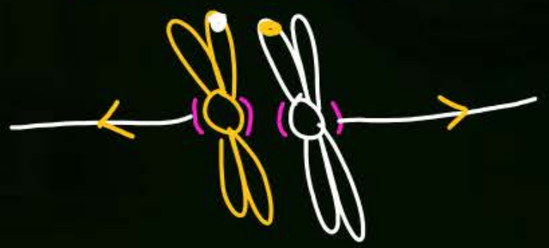


- Bivalent chromosomes align at equatorial plate (in 2 planes)
- Microtubules (= Spindle fibres) from opposite poles of spindle, attaches to Kinetochore of homologous chromosomes

Mitosis Metaphase



Meiosis-I / Metaphase-I



Anaphase I

→ Homologous chromosomes separate and move towards Opposite poles

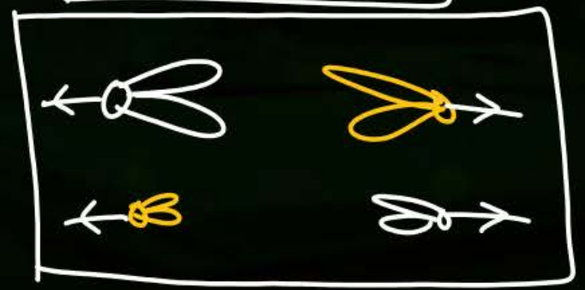
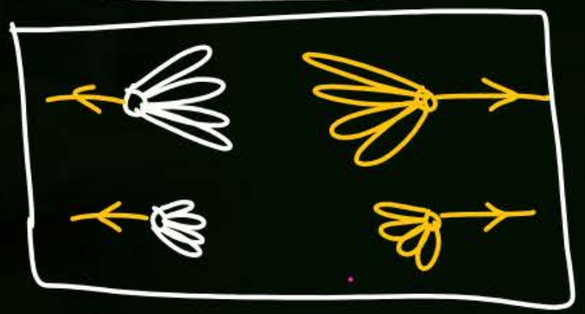
→ No Splitting of Centromere

AR

Reason

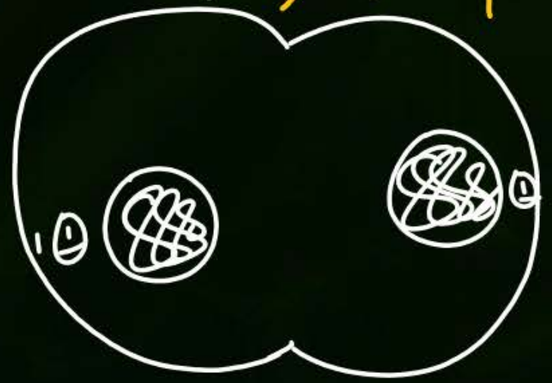
Assertion

Sister Chromatids remain associated at their Centromere i.e Sister chromatids Do NOT Separate

Anaphase Mitosis	Anaphase-I Meiosis-I
	

Telophase I

4C, 2n=4



2C
n=2

2C
n=2

- Chromosomes reach poles → decondense → Chromatin
- Meiotic Spindle dissolution
- Nuclear envelope reform, Nucleolus re-appear

↓

followed by Cytokinesis-I

↓

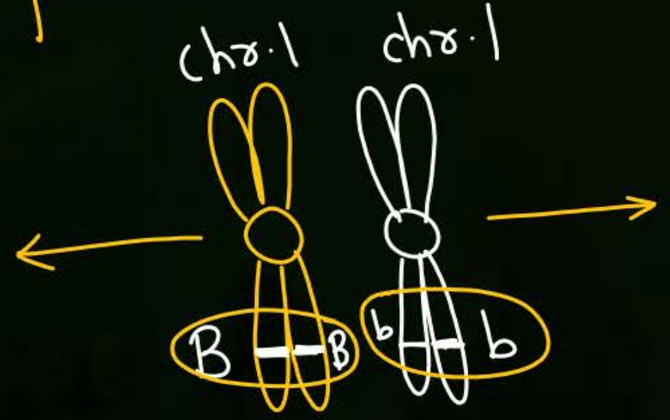
Dyad of Cells (2 daughter cells)

- DNA, same as Parent Cell (doubled in S-phase)
- Chromosome no., half " " " (Anaphase-I)

* Stage Responsible for –

1. Reduction of Chromosome no. to half
2. Disjunction (=Separation) of Mendelian factors (2 alleles)

} → Anaphase-I



Meiosis II → Just like Mitosis

- **Metaphase – II** → All chromosomes align at equator (in one plane)
  → Spindle fibres attaches to Kineto – chore of Sister chromatids

- **Anaphase – II** → Shortening of Microtubules (= Spindle fibres)
  ↓
  Centromere Split
  ↓
  Sister chromatids Separate from each – other & move towards opposite poles

QUESTION (Mastering NCERT)

Add in NOTES

What will be the amount of DNA in meiosis II products if meiocyte contains 30 pg DNA in G_2 phase?

(Parent Cell)

DNA → G_2 = 30 pg (Given)
→ S = 30 pg
→ G_1 = 15 pg
→ Parent Cell = 15

A 30 pg

B 15 pg

C 7.5 pg

D 60 pg

After m-II, DNA halves, as Parent cell 15 pg → 7.5 pg

Ques: in Meiosis-I products
DNA same as parent cell = 15 pg.

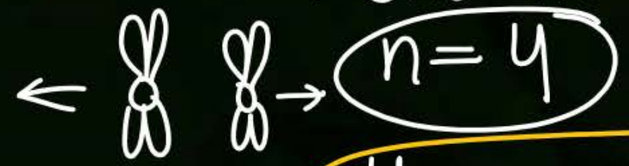
QUESTION (Mastering NCERT)

Add in NOTES

In an organism, if the normal diploid number of chromosomes is 8, how many chromatids are present in each daughter cell at the end of meiosis-I?

$2n = 8$ (Parent)

→ chr. no. halves



$n = 4$

4 chromosomes

8 chromatids

A 4

B 8 Chromatids

C 2

D 16

Master
NCERT
Concept se
Question tak!

except at the sites of crossovers. These X-shaped structures, are called **chiasmata.** In oocytes of some vertebrates, diplotene can last for months or years.

The final stage of meiotic prophase I is **diakinesis.** This is marked by terminalisation of chiasmata. During this phase the chromosomes are fully condensed and the meiotic spindle is assembled to prepare the homologous chromosomes for separation. By the end of diakinesis, the nucleolus disappears and the nuclear envelope also breaks down. Diakinesis represents transition to metaphase.

Metaphase I: The bivalent chromosomes align on the equatorial plate (Figure 10.3). The microtubules from the opposite poles of the spindle attach to the kinetochore of homologous chromosomes.

last

Anaphase I: The homologous chromosomes separate, while sister chromatids remain associated at their centromeres (Figure 10.3).

Telophase I: The nuclear membrane and nucleolus reappear, cytokinesis follows and this is called as dyad of cells (Figure 10.3). Although in many cases the chromosomes do undergo some dispersion, they do not reach the extremely extended state of the interphase nucleus. The stage between the two meiotic divisions is called interkinesis and is generally short lived. There is no replication of DNA during interkinesis. Interkinesis is followed by prophase II, a much simpler prophase than prophase I.

10.4.2 Meiosis II

Prophase II: Meiosis II is initiated immediately after cytokinesis, usually before the chromosomes have fully elongated. In contrast to meiosis I, meiosis II resembles a normal mitosis. The nuclear membrane disappears by the end of prophase II (Figure 10.4). The chromosomes again become compact.

Metaphase II: At this stage the chromosomes align at the equator and the microtubules from opposite poles of the spindle get attached to the kinetochores (Figure 10.4) of sister chromatids.

Anaphase II: It begins with the simultaneous splitting of the centromere of each chromosome (which was holding the sister chromatids together), allowing them to move toward opposite poles of the cell (Figure 10.4) by shortening of microtubules attached to kinetochores.

Telophase II: Meiosis ends with telophase II, in which the two groups of chromosomes once again get enclosed by a nuclear envelope; cytokinesis follows resulting in the formation of tetrad of cells i.e., four haploid daughter cells (Figure 10.4).

10.5 Significance of Meiosis

Meiosis is the mechanism by which conservation of specific chromosome number of each species is achieved across generations in sexually reproducing organisms, even though the process, per se, paradoxically, results in reduction of chromosome number by half. It also increases the genetic variability in the population of organisms from one generation to the next. Variations are very important for the process of evolution.

last Class

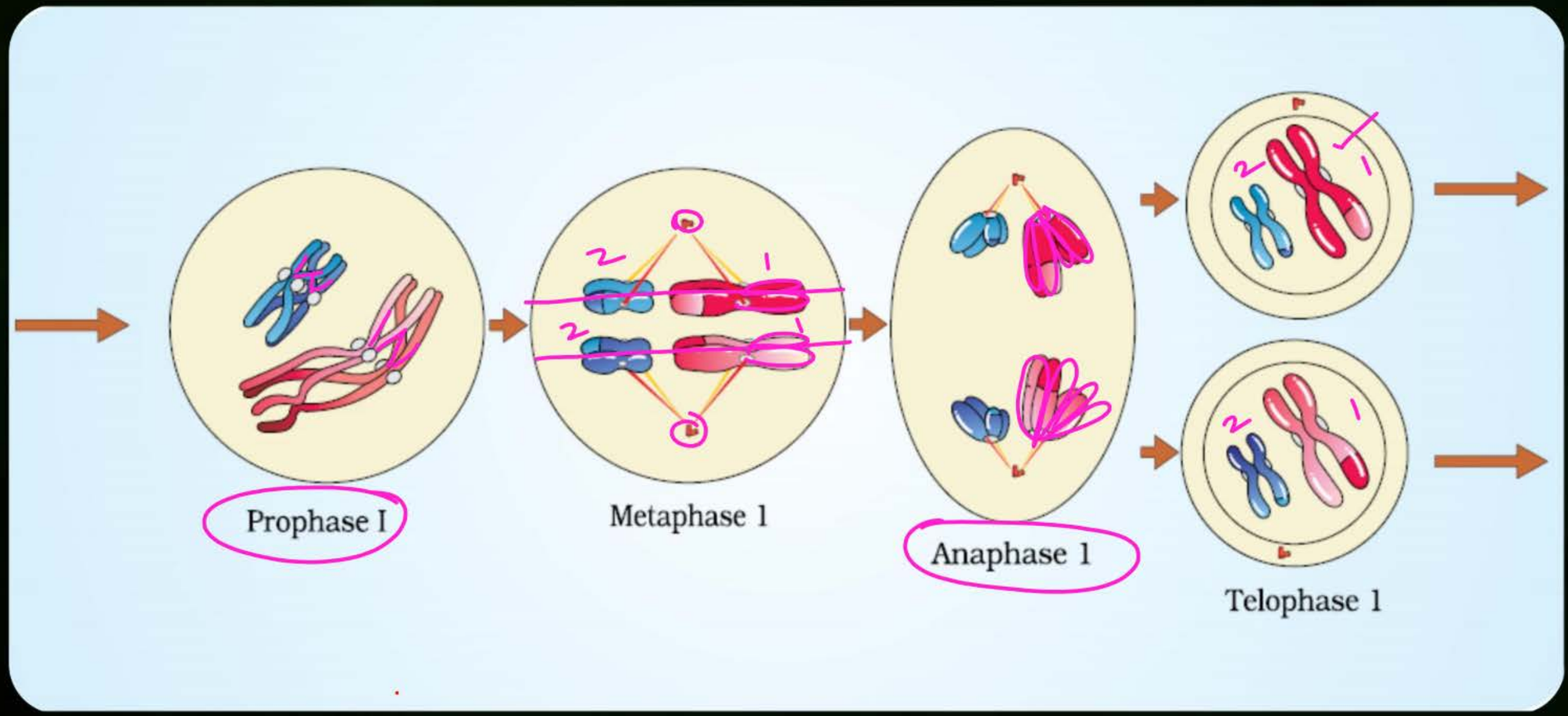


Fig. 10.3: Stages of Meiosis I

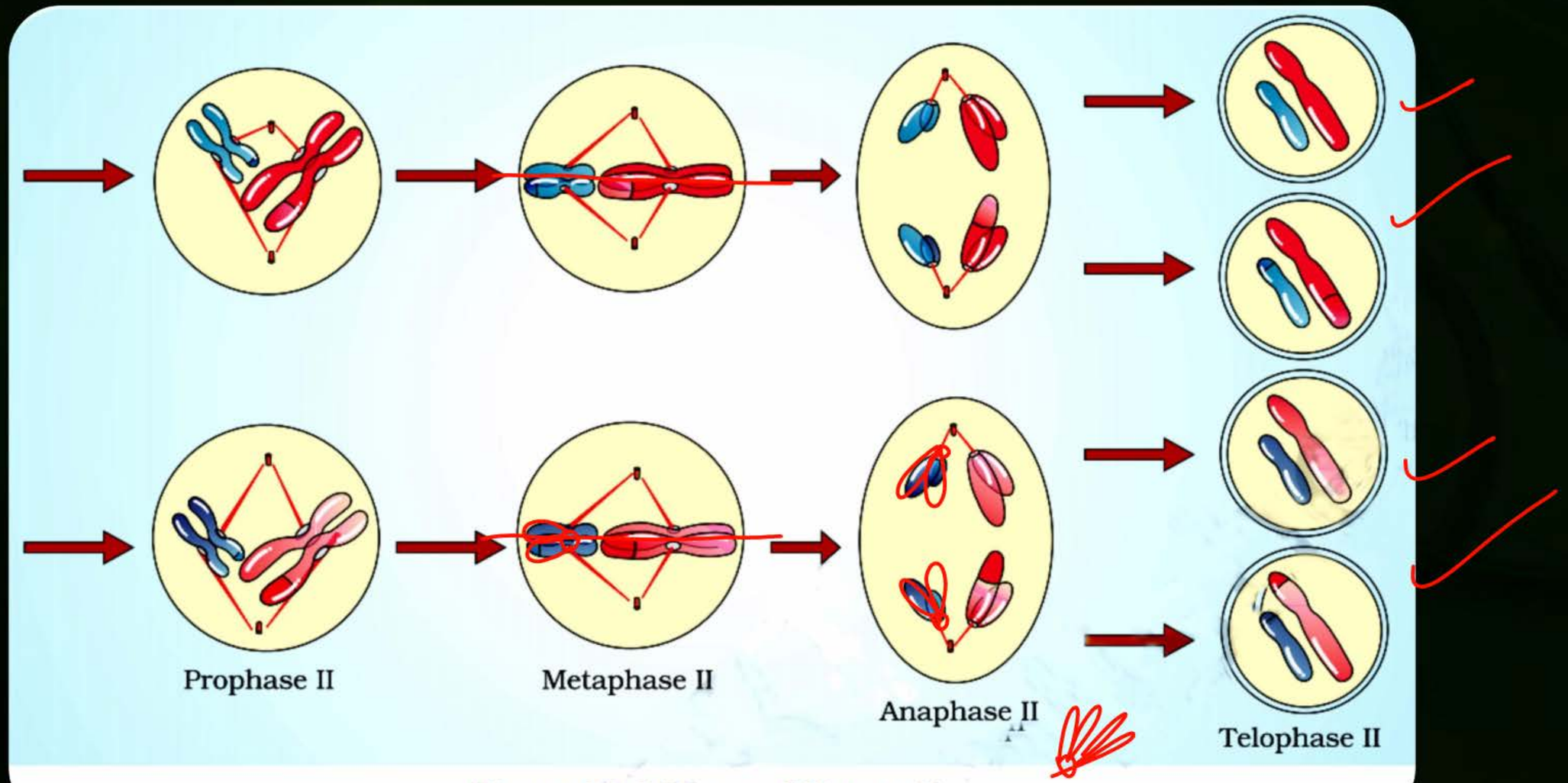


Figure 10.4 Stages of Meiosis II

H.W

Out of NCERT*

Check-points for Cell Cycle :-

Metaphase - Anaphase Check-point

(PYQ) once

- chr. align at equator
- Spindle attachment

I

G_1 / G_1-S Check-point

Checks for → Normal DNA

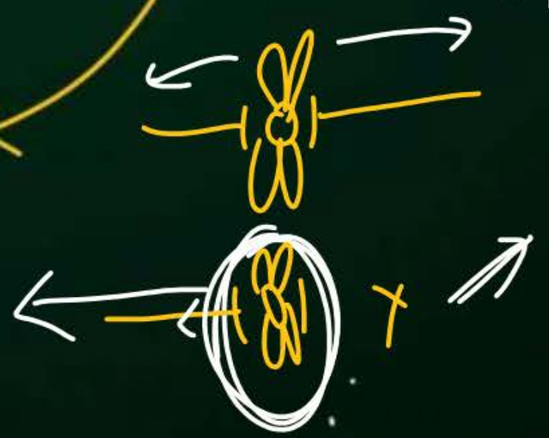
→ Raw material for DNA Replication

II

G_2 / G_2-M Check-point

Checks for-

a) Abnormal DNA
b) Centrosome duplication
c) Tubulin protein synthesis

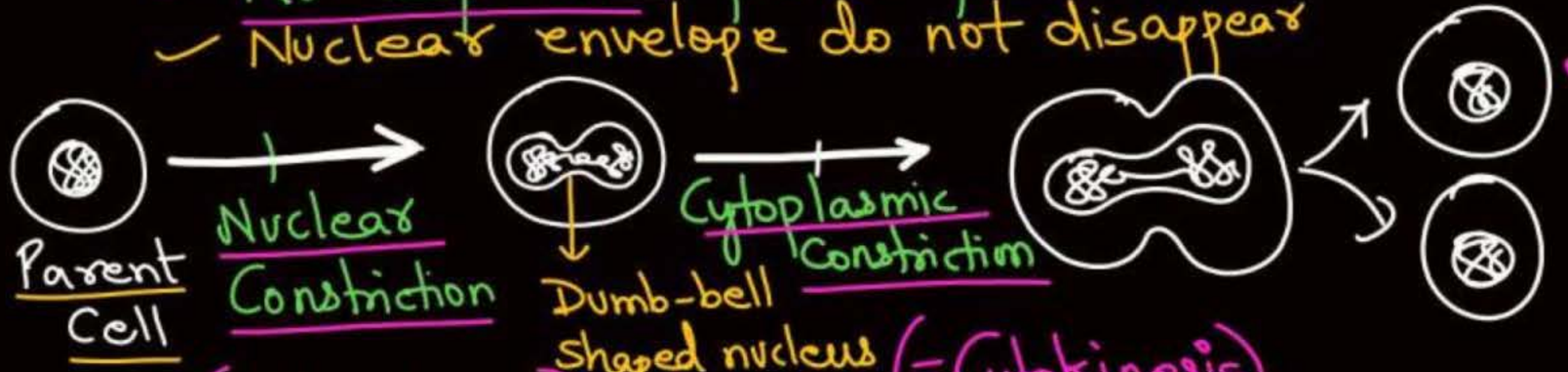


H.W Out of NCERT *

AMITOSIS = Direct Cell division

Absent thread/Spindle fibre

- No Chromatin Condensation
- No Chromosome formation
- No Spindle fibres formation
- Nuclear envelope do not disappear



(=Karyokinesis) followed by (=Cytokinesis)

eg: Bacteria, Blue-Green Algae

In Some protists (Paramoecium)

- Amitosis = BINARY FISSION (Mode of reproduction)

(Mode of cell division)

PYQ - 2017

Q: DNA Replication in Bacteria occurs in-

a) S-phase

b) Prior to fission ✓

QUESTION (Mastering NCERT)

Microtubules from opposite poles of spindle get attached to kinetochores of sister chromatids during

A Anaphase II

B Prophase II

C Metaphase II

D Metaphase I

QUESTION (Mastering NCERT)

At what stage, does the number of chromosomes become half?

A Prophase I

B Metaphase I

C Anaphase I

D Zygotene

QUESTION (Mastering NCERT)

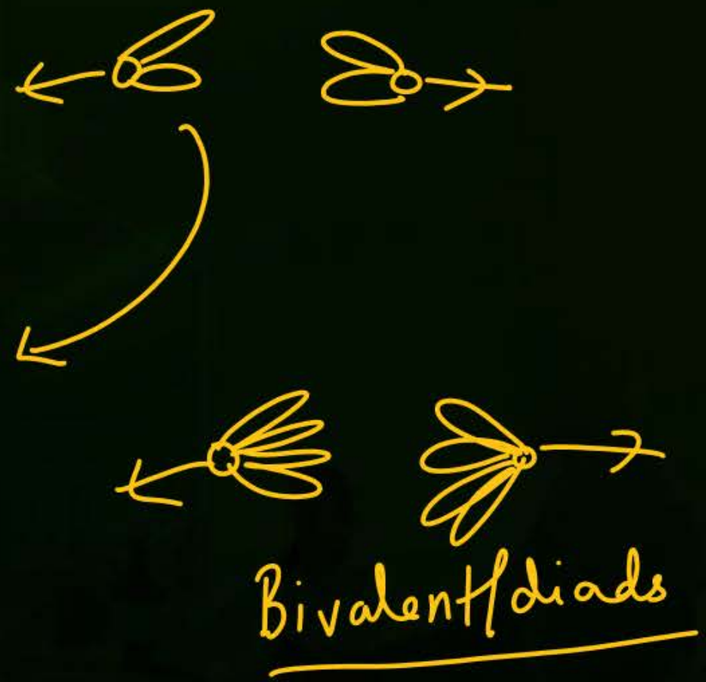
Poleward movement of diads occurs during

A Anaphase

B Anaphase I

C Anaphase II

D Telophase



QUESTION (Mastering NCERT)

In meiosis I, the centromere undergoes

A. Division between anaphase and interphase

B. Division between prophase and metaphase

C. Division but the daughter chromosomes do not separate

D. No division

QUESTION (Mastering NCERT)

Segregation of Mendelian factors (Aa) occurs during

A Diplotene

B Anaphase I

C Zygotene/Pachytene

D Anaphase II

Home - work

10 Ques

12 min timer

QUESTION (Mastering NCERT)

Arrange the following events of meiosis in correct sequence.

i. Crossing over
ii. Synapsis
iii. Terminalisation of chiasmata
iv. Disappearance of nucleolus

Zygo. Pachy. Diak. Diak

A ii, i, iii, iv

B i, ii, iii, iv

C ii, iii, iv, i

D ii, i, iv, iii

QUESTION (Mastering NCERT)

Select the correct option.

Column I		Column II
a.	Synapsis	i. Anaphase II
b.	Synthesis of RNA and protein	ii. Zygotene
c.	Action of enzyme recombinase	iii. G2 phase
d.	Centromeres do not separate but chromatids move towards opposite poles	iv. Anaphase I
		v. Pachytene

Sister togeth.

A a-(i), b-(ii), c-(v), d-(iv)

B a-(ii), b-(iii), c-(iv), d-(v)

C a-(ii), b-(i), c-(iii), d-(iv)

D a-(ii), b-(iii), c-(v), d-(iv)

QUESTION (Mastering NCERT)

In meiosis

A First division is reductional

B First division is equational

C Second division is reductional

D None of the above

QUESTION (Mastering NCERT)

Significance of meiosis lies in

A Production of genetic variability

B Maintaining constancy of chromosome number during sexual reproduction

C Reduction of chromosome number to one half

D All of the above

QUESTION (Mastering NCERT)

In how many cells meiotic division has taken place, if total number of sperms produced are 32?

A 4

B 8

C 16

D 32

1 meiosis ⟶ 4 Sperms

$\frac{32}{4} = 8$ meiosis ⟵ 32 ||

QUESTION (Mastering NCERT)

Add in notes

200 egg cells and 200 pollen grains are produced by how many meiotic divisions respectively?

A. 200, 400

B. 100, 200

C. 50, 100

D. 200, 50

1 meiosis ⟶ 4 P.G

$\frac{200}{4} = 50$ ⟵ 200 P.G

1 meiosis ⟶ 1 egg

QUESTION (Mastering NCERT)

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Given below are two statements:

Statement I: Chromosomes become gradually visible under light microscope during leptotene stage.

Statement II: The beginning of diplotene state is recognized by dissolution of synaptonemal complex.

In the light of the above statements, choose the correct answer from the options given below:

A Statement I is true but Statement II is false.

B Statement I is false but Statement II is true.

C Both Statement I and Statement II are true.

D Both Statement I and Statement II are false.

QUESTION (Mastering NCERT)

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Match List I with List II :
Choose the correct answer from the options given below:

	List I		List II
A.	Diakinesis	I.	Synaptonemal complex formation
B.	Pachytene	II.	Completion of terminalization of chiasmata
C.	Zygotene	III.	Chromosomes look like thin threads
D.	Leptotene	IV.	Appearance of recombination nodules

(A) A-II, B-IV, C-I, D-III

(B) A-IV, B-III, C-II, D-I

(C) A-IV, B-II, C-III, D-I

(D) A-I, B-II, C-IV, D-III

Immunity Booster
= Short Notes

* Metaphase - I → Bivalents align at equator
  → Spindle fibres attaches to kinetochore of Homologous chr.

* Metaphase - II → All chr. align at Equator
  → Spindle attaches to Kinetochore of Sister chromatids

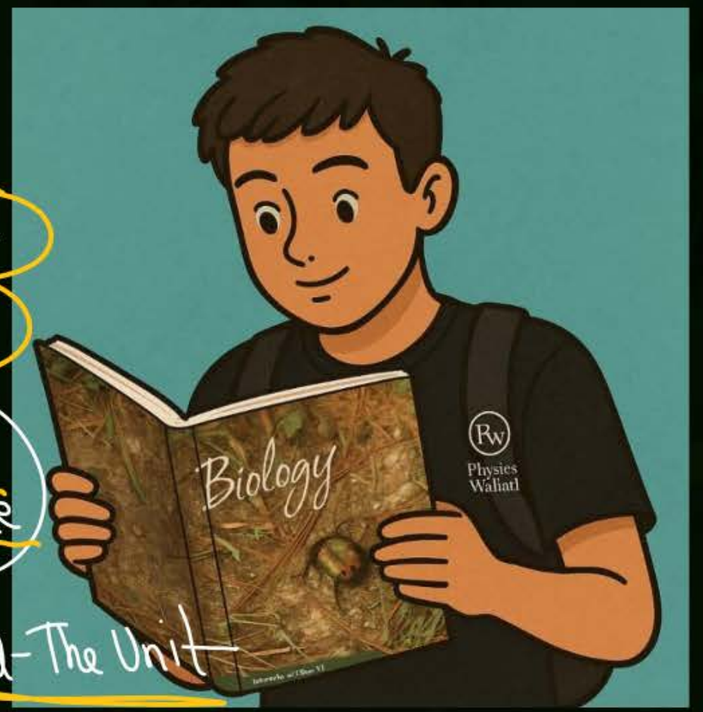
* Anaphase - I → Homologous chr. Separate; Sister chromatids remain associated at centromere (Centromere do not break)
  → Responsible for Reduction in chr. no.

* Anaphase - II → Centromere Split, Sister chromatids Separate.

Homework → Module → Today's topics

* Revise lec-4
* Learn lec-5
* DPP
* Read NCERT

* Sunday → Summary lec.
  PYQ lec.
* Monday → Podcast (Cell cycle)
* Tues → Summary lec
* Wed → " ½ ½ Cell-The Unit



THANK YOU